Space Weather Technical Forecast

Issued on Sunday, 27 August 2023 at 13:15 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of isolated M-flares (R1-R2 Blackouts). Glancing CME arrival possible day 4 (30 Aug) with slight chance of G1 Minor Storms.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with one long period M1.1 flare observed peaking 26/2250 UTC from an uncertain source over the east limb. There are six sunspot regions on the disc. There are five sunspot regions on the disc. Three of which are small and mature, however there are two visible sunspot groups of interest at this time. AR3415 in the southeast remains the most complex, with a persistent delta spot configuration, but has remained largely inactive. Furthermore, the segmented trailing umbra and also fading of the pores surrounding the spot suggests a reducing risk. The larger AR3413 near center disk has maintained small mixed polarity spots around its dominant spot, perhaps indicative of a slightly increased flare potential.

The CME from the C2.2 flare of AR3413 on the 25th has been analysed as likely containing an Earth-directed component, but very faint, with a glancing impact modelled for some time day 4 (30 Aug), however confidence is low with any potential impacts.

Solar Wind / Geomagnetic Activity: Observed solar winds by ACE at L1 were at background to slightly elevated levels, with a slow reduction from around 450km/s to 380km/s, though with recent signs of a slight increase once again. Density average to below average. The interplanetary magnetic field (IMF) Bt, was predominately Weak, below 8nT, but briefly peaked at Moderate (just over 8nT) between 26/2050-2130 UTC. The north-south component has been mainly negative (southward) with only brief periods of positive (northward) direction, varying between +5/-7nT. Phi angle was predominantly positive (away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux remained at Background. GOES16 high energy (greater than 2MeV) electron flux was mostly at Background, rising briefly to peak Moderate with 280 pfu at 26/1440 UTC. The associated 24-hour fluence was well below Active, with 5.52e6 integrated pfu observed at 27/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar Activity is expected to be generally Low, but with a chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: CME from C2.2 flare on 26 Aug is forecast to potentially arrive sometime on day 4 (30 Aug), however given the faint signal in coronagraph imagery confidence is low for any notable impact or increase to geomagnetic activity. Some fast wind impact associated with CH38/- is expected during day 1 (27 Aug), with speeds potentially rising to slightly elevated levels 450-500km/s. Geomagnetic activity expected to remain generally Quiet to Unsettled, with likely Active intervals, but only a slight chance of G1 Minor Storms. Winds then expected to ease day 2 onward (28 Aug). Mainly Quiet geomagnetic activity then expected, with

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isolated Unsettled intervals. Any CME arrival on day 4 will likely bring a spell of Unsettled to Active, with a slight chance of G1 Minor Storms but confidence is low.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is expected to remain at Background. High energy (greater than 2 MeV) electron flux is expected to persist at mainly Background to Moderate levels, with a slight chance of rising to High (1000 pfu) at peak periods late day 3 or early day 4 (29-30 Aug). The associated 24 hour fluence is expected to remain below the Active level (1e8 integrated pfu).

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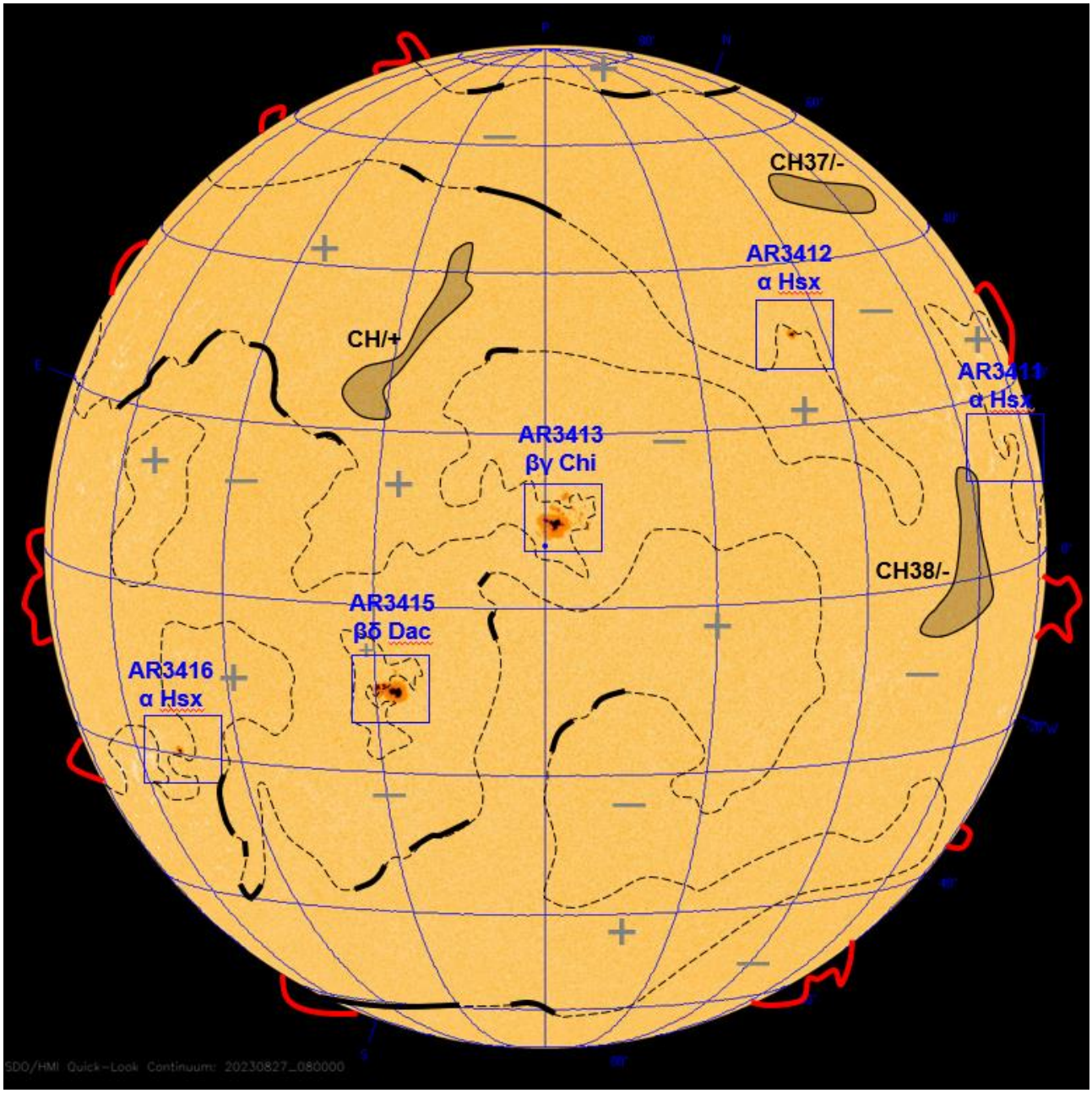
Figure 1. Solar Analysis Valid 27/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The C2.2 flare and associated dimming from AR3413 at 25/1006 UTC likely produced a CME, with a very faint eruption subsequently detected in SOHO imagery. Assessment of this suggest a glancing CME impact possible at Earth sometime on day 4 (30 Aug) though low confidence. There are no other Earth-directed CMEs currently forecast.

Some fast wind impact associated with CH38/- is expected during day 1 (27 Aug), with speeds potentially rising to slightly elevated levels 450-500km/s. Negative polarity coronal holes are unfavoured for a strong connection at this time of year, with geomagnetic activity expected to remain generally Quiet to Unsettled, with likely Active intervals, but only a slight chance of G1 Minor Storms. Winds then expected to ease day 2 onward (28 Aug), as supported by MOSWOC Enlil. Mainly Quiet geomagnetic activity then expected, with isolated Unsettled intervals. Any CME arrival on day 4 will likely bring a spell of Unsettled to Active, with a slight chance of G1 Minor Storms but confidence is low.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	5	1	15
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
26/1733	Partial	C2.2 flare	NW-centre disk	529km/s	30/1200 UTC +/- 10 hours	Low confidence. Directed SE, despite NW location

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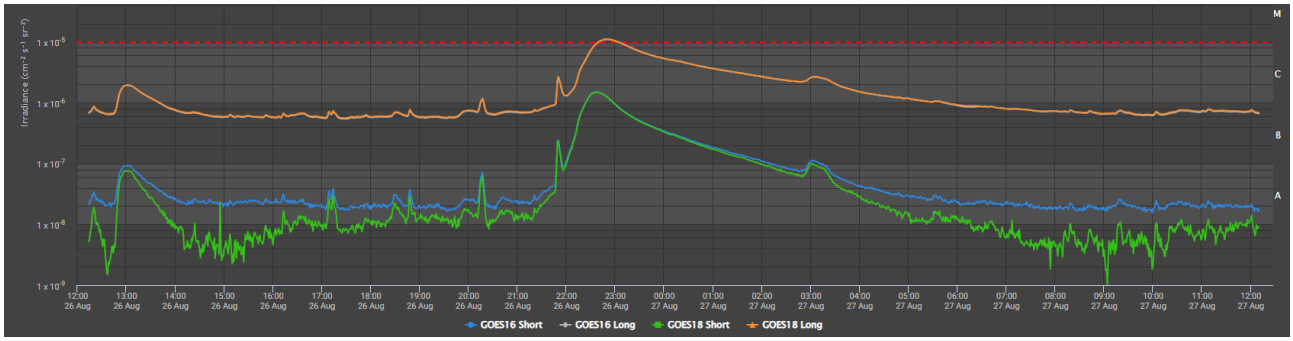
Radio Blackouts - X-Ray Flares:
Activity is currently Moderate with peak flare M1.1 at 26/2250 UTC from over the eastern limb. Generally low activity is expected during the forecast period, but there is a chance of further isolated M-flares, either from AR3413/AR3415 or perhaps more likely from the region approaching the east limb, with a very slight chance of an isolated X-flare.

There are five sunspots on the disc. The largest region AR3413 in the centre disc, which despite the continued emergence of small opposite polarity spots around the main dominate leader has continued to see generally limited activity. AR3415 in the southeast has also remained largely stable despite its clear delta configuration. The other regions are all simple, mature and inactive unipolar spots.

The source of the M-flare on 26 Aug was just over the east limb, and looks likely to increase activity once it rotates onto the eastern disc, however the timing of this is currently uncertain given a lack of conclusive far side data, with a slight increase highlighted for now into days 3 and 4 (29-30 Aug).

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	25	25	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 2: Latest 24hr X-ray flux trace.



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Solar Radiation Storms - (High Energy Protons):
High energy (greater than 10MeV) proton flux observed by GOES16 is expected to remain at Background with just a very slight chance of enhancement. The main risk of any increased proton flux would be from the occurrence of any larger flares of AR3415 or AR3413.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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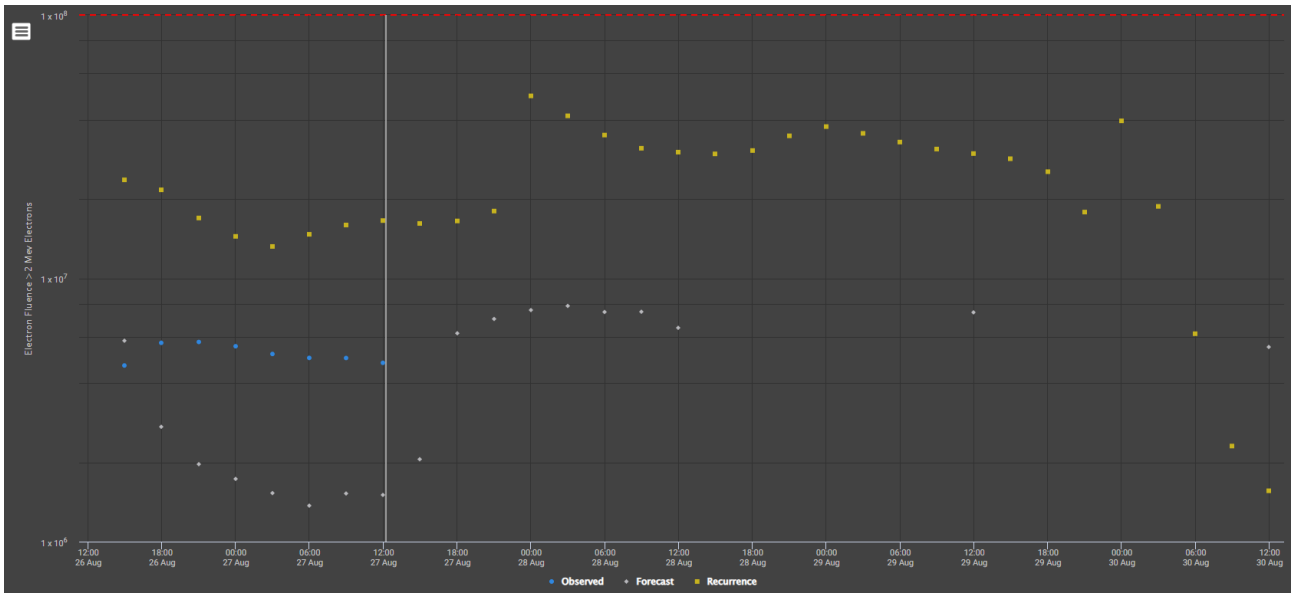
High Energy Electrons Event (≥ 2MeV):
High energy (greater than 2 MeV) electron flux observed by GOES16 persisted at mainly background levels, with only a subdued response to the recent high speed stream. An anticipated further fast wind arrival some time later day 1 (27 Aug) may bring a risk of further enhancement into the period. However, given the limited geomagnetic response anticipated, any increase to the observed flux expected to be rather limited, likely peaking at Moderate and only a slight chance of reaching High at diurnal maximum, particularly given any geomagnetism response into day 4 (30 Aug) from a possible glancing CME arrival.

The associated 24 hour fluence is expected to remain below the Active (1e8 integrated pfu) level, perhaps rising later the period in response to any enhancement. Below Active fluence is currently supported by REFM.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	5	10	10
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 3: Latest MOSWOC REFM model output



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